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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/253,306	02/19/1999	DONALD S. GARDNER	042390.P5832	5456

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EXAMINER

TRAN, THIEN F

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 01/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/253,306

Applicant(s)

GARDNER ET AL.

Examiner

Thien F Tran

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 4-6,9-11,14-16 and 19-22 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 4-6,9-11,14-16 and 19-22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_ 6) ☐ Other:

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4, 5, 9, 10, 14, 15 and 22 and are rejected under 35 U.S.C. 103(a) as being unpatentable over Shin (USPN 5,665,643) in view of Ryan et al. (USPN 5,243,221) and Ouellet (USPN 5,747,361).

Shin discloses a semiconductor device (Fig. 2) comprising an interconnection structure 22 formed on a substrate 20, the interconnection structure comprises an aluminum copper titanium alloy layer 22c. Shin does not explicitly disclose the aluminum copper titanium alloy layer containing 0.1 atomic percent titanium (same as about 0.18 weight percent titanium), and about 0.5 atomic percent copper. Ryan et al. discloses an interconnection comprising an aluminum alloy layer that contains 0.5 atomic percent of copper (see col. 1, lines 57-62). It would have been obvious to a person having ordinary skill in the art at the time the invention was made to form the aluminum copper titanium alloy layer of Shin having 0.5 atomic percent of copper as taught by Ryan et al. in order to avoid electromigration problems. Ouellet discloses an aluminum alloy layer used as the interconnection layer containing 1.25 weight percent to 0.05 weight percent of titanium (see col. 19, lines 25-50). It would have been obvious to a person having ordinary skill in the art at the time the invention was made to form

Art Unit: 2811

the aluminum copper titanium alloy layer of Shin having about 0.1 atomic percent titanium which is equivalent to about 0.18 weight percent as taught by Ouellet so that the presence of the titanium in the aluminum alloy layer can avoid electromigration problems, prevent the reaction of the metal barrier layer with the aluminum alloy layer, and also keep the titanium content of the aluminum alloy at a minimum to ensure the lowest possible bulk resistivity. As a result, the modified Shin would provide an interconnection comprising an aluminum copper titanium alloy layer 22c having the composition of titanium, copper and aluminum as claimed.

Regarding claim 22, the combined teachings of Shin, Ryan and Ouellet discloses the interconnect having composition of titanium, copper and aluminum as claimed, it is inherent that the interconnect of the combined references has a resistance in the claimed range.

Claims 6, 11, 16, and 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shin (USPN 5,665,643) in view of Ryan et al. (USPN 5,243,221) and Ouellet (USPN 5,747,361) as applied to claims 4, 5, 9, 10, 14, 15 and 22 above, and further in view of Inoue et al. (USPN 5,635,763).

Combined teachings of Shin, Ryan and Ouellet as described in details above further disclose a double-layered structure having a second titanium nitride layer 22b and a second titanium layer 22a under the aluminum copper titanium alloy layer 22c. The modified Shin does not disclose another double-layered structure having a first titanium nitride layer and a first titanium layer above the aluminum copper titanium alloy layer. Inoue et al. discloses a semiconductor device comprising a multilayered

Art Unit: 2811

interconnection structure (Fig. 3A) formed on a substrate 1, the interconnection structure comprises a double layered structure of a second titanium nitride layer 9 overlying a second titanium layer 21, wherein the double layered structure is formed under an aluminum alloy layer 10; and another double layered structure 32 of a first titanium nitride layer 11 overlying a first titanium layer 23 wherein the another double layered structure is formed above the aluminum alloy layer 10. It would have been obvious to a person having ordinary skill in the art at the time the invention was made to incorporate another double-layered structure having a first titanium nitride layer and a first titanium layer above the aluminum copper titanium alloy layer 22c of the modified Shin as taught by Inoue et al. in order to suppress the migration of aluminum atoms and thus improve the electromigration performance of the interconnection. The TiN/Ti double layered cap also has an excellent reflection suppressing effect and reduces the contact resistance.

### ***Response to Arguments***

Applicant's arguments with respect to claim 22 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's arguments filed 10-28-2002 have been fully considered but they are not persuasive.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208

Art Unit: 2811

USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

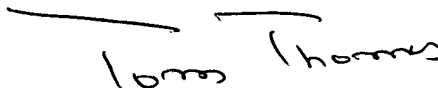
Art Unit: 2811

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thien F Tran whose telephone number is (703) 308-4108. The examiner can normally be reached on 8:30AM - 5:00PM Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A handwritten signature in black ink that reads "Tom Thomas". The signature is written in a cursive style with a horizontal line above the name.

tt  
January 3, 2003

TOM THOMAS  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2800